



Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

GCSE CHEMISTRY

F

Foundation Tier

Paper 1

Thursday 16 May 2019

Morning

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a ruler
- a scientific calculator
- the periodic table (enclosed).

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information

- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	



J U N 1 9 8 4 6 2 1 F 0 1

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8462/1F

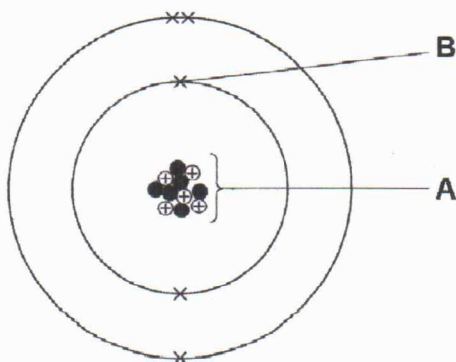
Answer **all** questions in the spaces provided.

0 1

This question is about atomic structure.

Figure 1 represents an atom of element Z.

Figure 1



0 1 . 1

Name the parts of the atom labelled **A** and **B**.

Choose answers from the box.

[2 marks]

electron

neutron

nucleus

proton

A NucleusB electron

0 1 . 2

Which particle has the lowest mass?

Choose the answer from the box.

Neutrons of Mass 1
Protons have mass of 1

[1 mark]

electron

neutron

nucleus

proton

Electron

0 1 . 3

Which group of the periodic table contains element Z?

Use Figure 1.

[1 mark]

Group three (It has three electrons
in the outer shell.)

0 1 . 4

Give the atomic number and the mass number of element Z.

Use Figure 1.

Choose answers from the box.

[2 marks]

1

5

6

11

16

Atomic number 5Mass number 11

Mass number = Neutrons
+ Protons.

Question 1 continues on the next page

Turn over ►



Bromine has two different types of atom.

The atoms have a different number of neutrons but the same number of protons.

0 1 . 5

What is the name for this type of atom?

[1 mark]

Tick (✓) **one** box.

Compound

☐

- two or more atoms chemically combined

Ion

☐

- It is an electrically charged particle.

Isotope

☒

Molecule

☐

0 1 . 6

The different types of bromine atom can be represented as $^{79}_{35}\text{Br}$ and $^{81}_{35}\text{Br}$

The relative atomic mass (A_r) of bromine is 80

Which statement is true about the number of each type of atom in bromine?

[1 mark]

Tick (✓) **one** box.

There are fewer $^{79}_{35}\text{Br}$ atoms than $^{81}_{35}\text{Br}$ atoms.

☐

There are more $^{79}_{35}\text{Br}$ atoms than $^{81}_{35}\text{Br}$ atoms.

☐

There are the same number of $^{79}_{35}\text{Br}$ atoms and $^{81}_{35}\text{Br}$ atoms.

☒

0 2

This question is about compounds of oxygen and hydrogen.

Figure 2 represents the structure of hydrogen peroxide.

Figure 2



0 2 . 1

What is the correct formula of hydrogen peroxide?

[1 mark]

Tick (✓) one box.

H₂O₂☐HO₂☐H²O²☐H₂O₂☒

0 2 . 2

Which type of bonding is shown in Figure 2?

[1 mark]

Tick (✓) one box.

Covalent

☒

Ionic

☐

Metallic

☐

Bonding between Metal and non-Metal.
-Bonding involving metals.

Turn over ►



0 2 3 Hydrogen peroxide decomposes in the presence of a catalyst.

Which elements are often used as catalysts?

[1 mark]

Tick (✓) one box.

Alkali metals

☐

They are group 1 (Na, K and Li)

Halogens

☐

They are group 7 (F₂, Cl₂, Br₂, I₂).

Transition metals

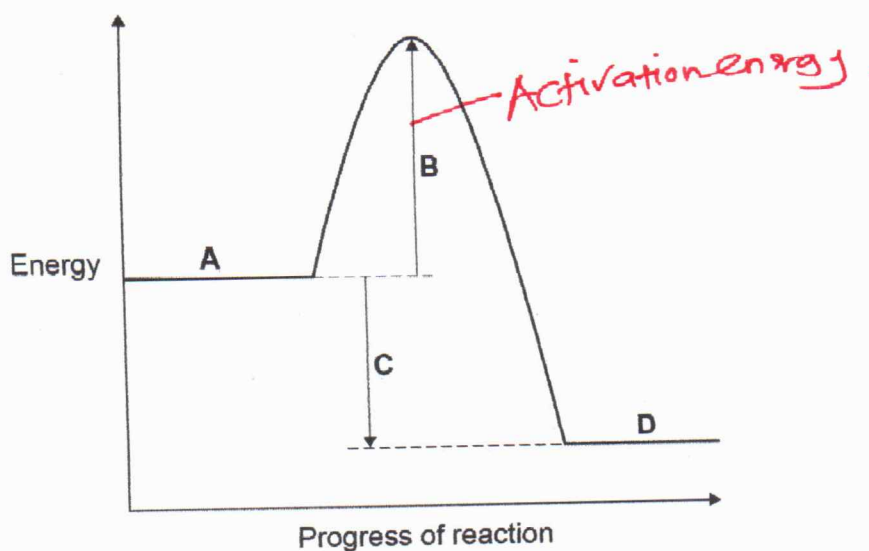
☒

Figure 3 shows the reaction profile for the decomposition of hydrogen peroxide.

The word equation for this reaction is:



Figure 3



Labels A, B, C and D each represent a different part of the reaction profile.

Use **Figure 3** to answer Questions 02.4 and 02.5

0 2 . 4 Which label shows the activation energy?

[1 mark]

Tick (✓) one box.

A	☐	B	☒	C	☐	D	☐
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0 2 . 5 Which label shows the energy of hydrogen peroxide?

[1 mark]

Tick (✓) one box.

A	☒	B	☐	C	☐	D	☐
---	-------------------------------------	---	--------------------------	---	--------------------------	---	--------------------------

0 2 . 6 The decomposition of hydrogen peroxide gives out energy to the surroundings.

What type of reaction is this?

[1 mark]

Tick (✓) one box.

Displacement	☐	
Endothermic	☐	Heat is absorbed.
Exothermic	☒	
Neutralisation	☐	When acid and alkali react.

Question 2 continues on the next page

Turn over ►



0 2 . 7 Hydrogen and oxygen form water.

A hydrogen atom contains one electron.

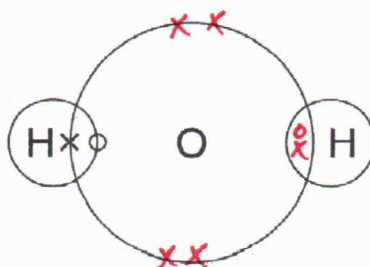
An oxygen atom contains six electrons in the outer shell.

Complete **Figure 4** to show a dot and cross diagram for a water molecule.

Show the outer electrons only.

[2 marks]

Figure 4



Covalent bonding - Involves sharing pairs
(lone pairs) of electrons.



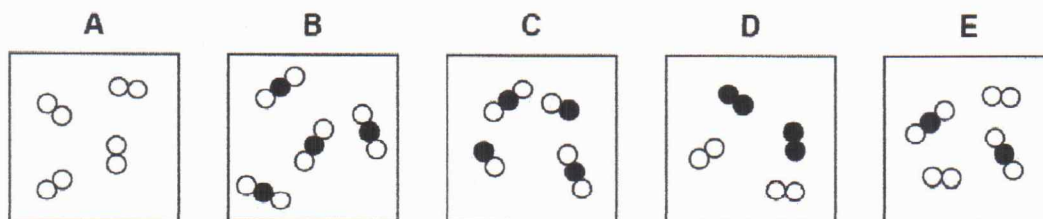
03

This question is about elements, compounds and mixtures.

Figure 5 shows five different substances, A, B, C, D and E.

○ and ● represent atoms of different elements.

Figure 5



Use Figure 5 to answer Questions 03.1 to 03.3

03

1

Which substance is only one compound?

[1 mark]

Tick (✓) one box.

A

☐

B

☒

C

☐

D

☐

E

☐

03

2

Which substance is a mixture of elements?

[1 mark]

Tick (✓) one box.

A

☐

B

☐

C

☐

D

☒

E

☐

03

3

Which substance is a mixture of an element and a compound?

[1 mark]

Tick (✓) one box.

A

☐

B

☐

C

☐

D

☐

E

☒

Turn over ►



Substances are separated from a mixture using different methods.

0 3 . 4

Draw **one** line from each method of separation to the substance and mixture it would separate.

[2 marks]

Method of separation	Substance and mixture
chromatography	blue food colour from a mixture of food colours
	copper from an alloy of copper and zinc
crystallisation	copper sulfate from copper sulfate solution
	ethanol from a mixture of ethanol and water



0 3 5

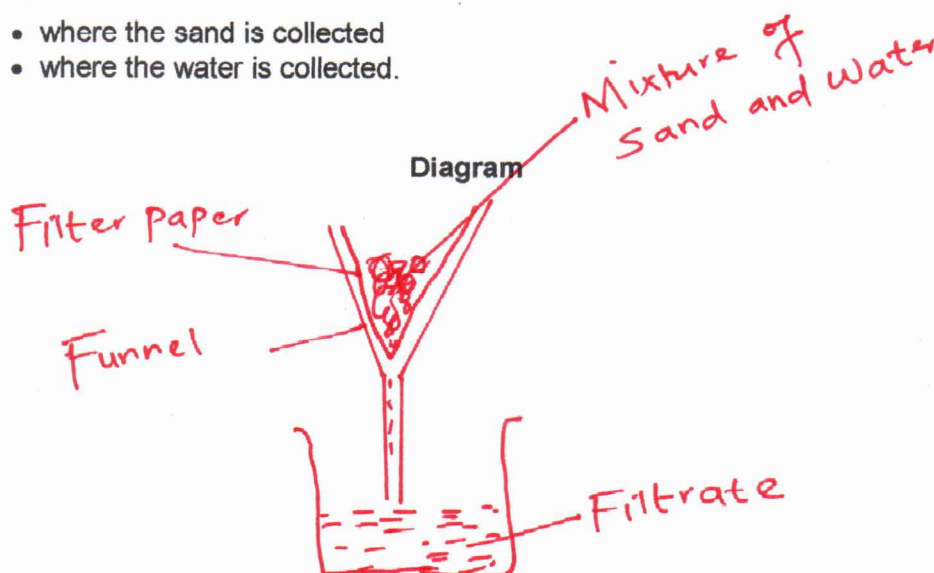
Sand does not dissolve in water. A student separates a mixture of sand and water by filtration.

Draw a diagram of the apparatus the student could use.

You should label:

- where the sand is collected
- where the water is collected.

[3 marks]



The Water passes through the filter paper.
The Substances (Sand Particles) left on
the filter paper are the residue.

Question 3 continues on the next page

Turn over ►

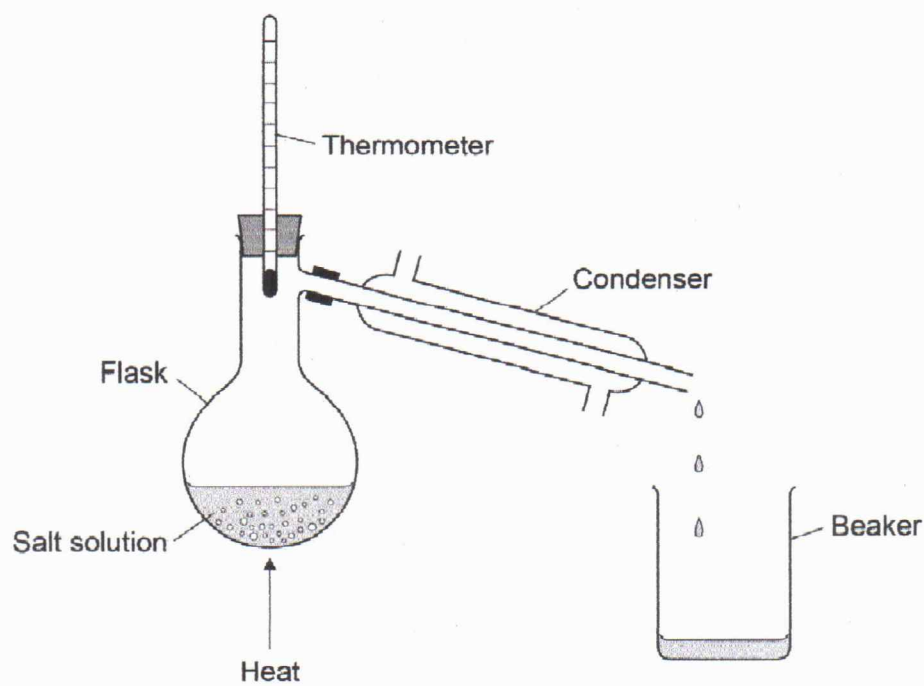


0 3 . 6

A student distils a sample of salt solution to produce pure water.

Figure 6 shows the apparatus.

Figure 6



What temperature would you expect the thermometer to show?

[1 mark]

Tick (✓) **one** box.

0 °C

☐

10 °C

☐

50 °C

☐

100 °C

☒

0 3 7

Describe how the process of distillation shown in Figure 6 produces pure water from salt solution.

[4 marks]

The salt solution in the flask is heated until it boils. The water turns into a gas but the salt stays behind in the flask. The steam passes into the condenser. The condenser is a tube which is surrounded by a layer of cold water. This cools the steam, which turns it back into a liquid. The distillate is pure water.

13

Turn over for the next question

Turn over ►



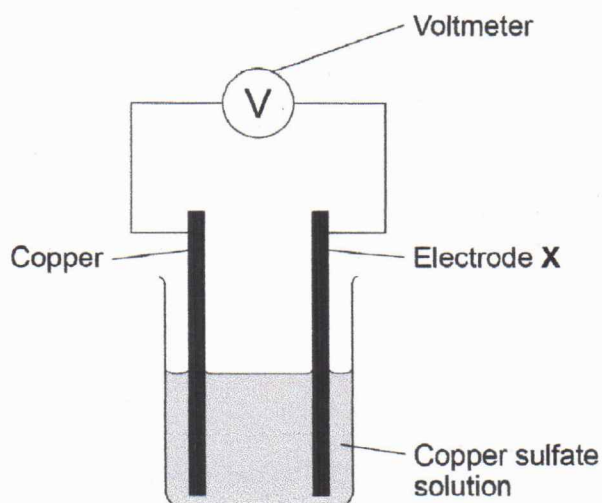
0 4

This question is about chemical cells and batteries.

A student investigated the voltage produced by different chemical cells.

Figure 7 shows the apparatus.

Figure 7



This is the method used.

1. Use cobalt metal as electrode X.
2. Record the cell voltage.
3. Repeat steps 1 and 2 using different metals as electrode X.

0 4 . 1

Suggest two variables the student should keep the same to make the investigation valid.

[2 marks]

- 1 The concentration of the electrolyte
should be same.
- 2 The temperature of the electrolyte.



Table 1 shows the student's results.

Table 1

Electrode X	Voltage of the cell in volts
cobalt	0.62
magnesium	2.71
zinc	1.10

0 4 . 2 Write the three metals used for electrode X in order of reactivity.

Use Table 1.

[1 mark]

Most reactive

Magnesium

Zinc

Least reactive

Cobalt

0 4 . 3 Copper is used as electrode X in Figure 7.

Predict the voltage of this cell.

Give one reason for your answer.

[2 marks]

Voltage = 0 volts

Reason The two electrodes are the same metal
thus two different metals are needed
to produce a voltage.

Turn over ►



0 4 . 4

Describe how to make a 12 V battery using 1.5 V cells.

[2 marks]

You are required to connect the cells in series, that means using 8 cells of 1.5V. ($\frac{12}{1.5} = 8$ cells).

0 4 . 5

Which is the most suitable use for a non-rechargeable cell?

[1 mark]

Tick (✓) one box.

Electric toy

☒

Laptop computer

☐

Mobile phone

☐

0 4 . 6

Hydrogen fuel cells or rechargeable cells can be used to power electric vehicles.

Suggest one advantage and one disadvantage of using a hydrogen fuel cell compared with a rechargeable cell.

[2 marks]

Advantage of hydrogen fuel cell

They are faster to refuel compared to a rechargeable cell.

Disadvantage of hydrogen fuel cell

The hydrogen is made from non-renewable resources.
- The hydrogen is flammable and can catch fire easily.



0 5

A student investigated the reaction between lumps of calcium carbonate and dilute hydrochloric acid.

This is the method used.

1. Pour 100 cm³ of dilute hydrochloric acid into a conical flask.
2. Place the conical flask on a balance.
3. Add 2 g of calcium carbonate lumps to the conical flask.
4. Wait until the calcium carbonate stops reacting.
5. Record the decrease in mass of the conical flask and contents.
6. Repeat steps 1 to 5 three more times.

The equation for the reaction is:



0 5 . 1

What is the state symbol X in the equation?

[1 mark]

Tick (✓) **one** box.

aq ☐ g ☐ l ☐ s ☒



Table 2 shows the student's results.

Table 2

	Result 1	Result 2	Result 3	Result 4
Decrease in mass of the conical flask and contents in g	0.84	0.79	0.86	0.47

0 5 . 2 Why does the mass of the conical flask and contents decrease during the reaction? [1 mark]

Tick (✓) one box.

*The gas produced is Carbondioxide
and If no bung the gas escapes.*

A gas escapes.

☒

A new solution is made.

☐

The dilute hydrochloric acid is used up.

☐

The calcium carbonate lumps decrease in size.

☐

0 5 . 3 What is the range of the four results in Table 2? [1 mark]

*Range consider highest
Mass and the lowest.*

From 0.47 g to 0.86 g

0 5 . 4 Calculate the mean decrease in mass of the conical flask and contents.

Do not include the anomalous result.

Use Table 2.

[2 marks]

$$\text{Mean of Masses} = \frac{0.84 + 0.79 + 0.86}{3}$$

$$= \frac{2.49}{3} = 0.83$$

Mean decrease in mass = 0.83 g

Turn over ►

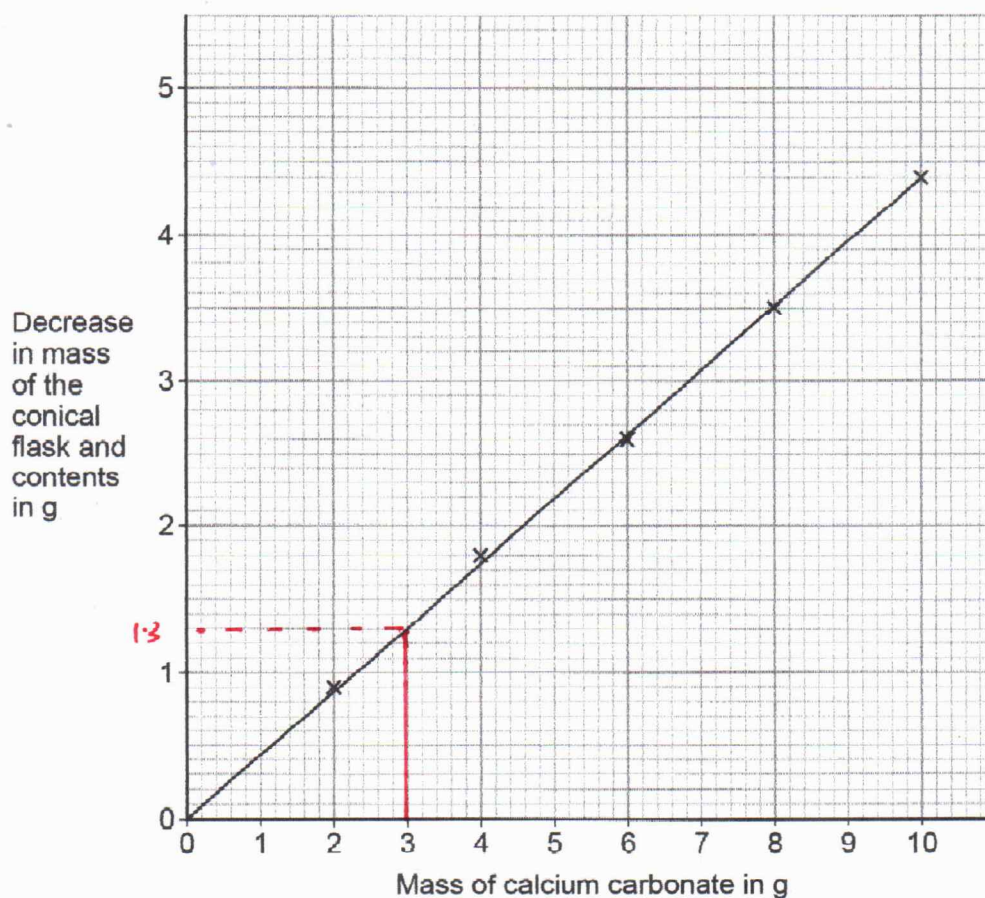


A teacher demonstrated the investigation.

The teacher used different masses of calcium carbonate.

Figure 8 shows the teacher's results.

Figure 8



0 5 . 5

What type of variable is the mass of calcium carbonate?

[1 mark]

Tick (✓) **one** box.

Control

☐

Dependent

☐

Independent

☒

Use Figure 8 to answer Questions 05.6 and 05.7

05.6

Complete the sentence.

[1 mark]

As the mass of calcium carbonate used increases, the decrease in mass of
the conical flask and contents Increases.

05.7

What is the decrease in mass of the conical flask and contents when a 3 g sample of
calcium carbonate is used?

[1 mark]

Decrease in mass = 1.3 g

8

Turn over for the next question

Turn over ►



0 6

This question is about the extraction of metals.

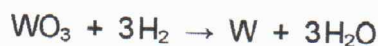
0 6 . 1

Tungsten is a metal.

The symbol of tungsten is W

Tungsten is produced from tungsten oxide by reaction with hydrogen.

The equation for the reaction is:



Calculate the percentage atom economy when tungsten is produced in this reaction.

Use the equation:

$$\text{percentage atom economy} = \frac{184}{(M_r \text{ WO}_3) + (3 \times M_r \text{ H}_2)} \times 100$$

Relative formula masses (M_r): $\text{WO}_3 = 232$ $\text{H}_2 = 2$

[2 marks]

$$\begin{aligned} \text{Percentage atom economy} &= \left(\frac{184}{232 + 3 \times 2} \right) \times 100\% \\ &= \frac{184}{244} \times 100\% \\ &= 0.7541 \times 100\% = 75.4\% \end{aligned}$$

Percentage atom economy = 75.4 %

Aluminium is extracted from aluminium oxide.

0 6 . 2

38% of a rock sample is aluminium oxide.

Calculate the mass of aluminium oxide in 40 kg of the rock sample.

[2 marks]

38% → Rock sample.

$$\text{Mass of } \text{Al}_2\text{O}_3 = \frac{38}{100} \times 40$$

$$= 15 \text{ kg}$$

Mass of aluminium oxide = 15 kg

0 6 . 3

The formula of aluminium oxide is Al_2O_3

Calculate the relative formula mass (M_r) of aluminium oxide.

Relative atomic masses (A_r): O = 16 Al = 27

[2 marks]

R.F.M Al_2O_3

$$(27 \times 2) + (16 \times 3)$$

$$54 + 48$$

$$= 102$$

Relative formula mass (M_r) = 102

Question 6 continues on the next page

Turn over ►



06.4

60.0 kg of aluminium oxide produces a maximum of 31.8 kg of aluminium.

In an extraction process only 28.4 kg of aluminium is produced from 60.0 kg of aluminium oxide.

Calculate the percentage yield.

Give your answer to 3 significant figures.

Use the equation:

$$\text{percentage yield} = \frac{\text{mass of product actually made}}{\text{maximum theoretical mass of product}} \times 100$$

[3 marks]

Mass of Product = 28.4 kg

Maximum theoretical
Mass = 31.8

$$\% \text{ Yield} = \frac{28.4}{31.8} \times 100\%$$

$$= 89.308\%$$

$$\approx 89.3\%$$

$$\text{Percentage yield} = 89.3\%$$

06.5

Extracting metals by electrolysis is a very expensive process.

Explain why aluminium is extracted using electrolysis and not by reduction with carbon.

[2 marks]

Aluminium is more reactive than carbon,
so carbon cannot displace aluminium.
The carbon cannot remove oxygen from
aluminium oxide.



0 7

This question is about energy changes in reactions.

0 7 . 1

Ammonium nitrate dissolves in water.

The change is endothermic.

Which piece of equipment uses this change?

[1 mark]

Tick (✓) **one** box.

Hand warmer

☐

Self-heating can

☐

Sports injury pack

☒

A student investigated the temperature change in the reaction between dilute sulfuric acid and potassium hydroxide solution.

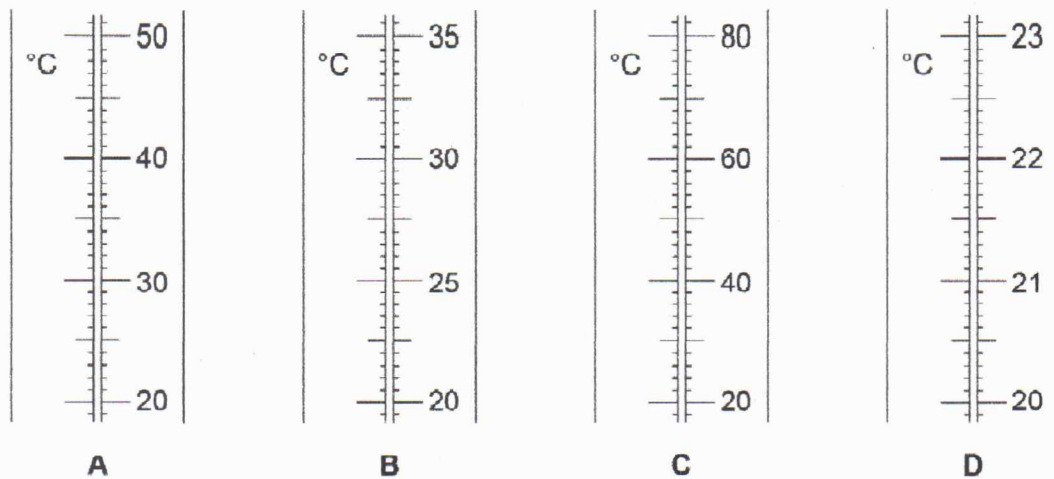
This is the method used.

1. Measure 25 cm³ of potassium hydroxide solution into a glass beaker.
2. Add 5 cm³ of dilute sulfuric acid.
3. Stir the solution.
4. Measure the temperature of the solution.
5. Repeat steps 2 to 4 until a total of 30 cm³ of dilute sulfuric acid has been added.



0 7 . 2 Figure 9 shows part of the scales of four thermometers, A, B, C and D.

Figure 9



The student wanted to measure the temperature to a resolution of 0.1 °C

Which thermometer should the student use?

[1 mark]

Tick (✓) **one** box.

A

☐

B

☐

C

☐

D

☒

0 7 . 3 Energy is lost to the surroundings during the reaction.

What type of error does this cause in the results?

[1 mark]

Tick (✓) **one** box.

Human error

☐

Random error

☐

Systematic error

☒

Zero error

☐

Turn over ►



0 7 . 4 The student used a glass beaker for the reaction.

Name a container the student could use instead of the glass beaker to improve the accuracy of the results.

[1 mark]

A polystyrene cup.

0 7 . 5 Table 3 shows the student's results.

Table 3

Volume of dilute sulfuric acid added in cm ³	Temperature in °C
5	21.2
10	22.0
15	22.8
20	23.6
25	24.4
30	25.2

Plot the data from Table 3 on Figure 10.

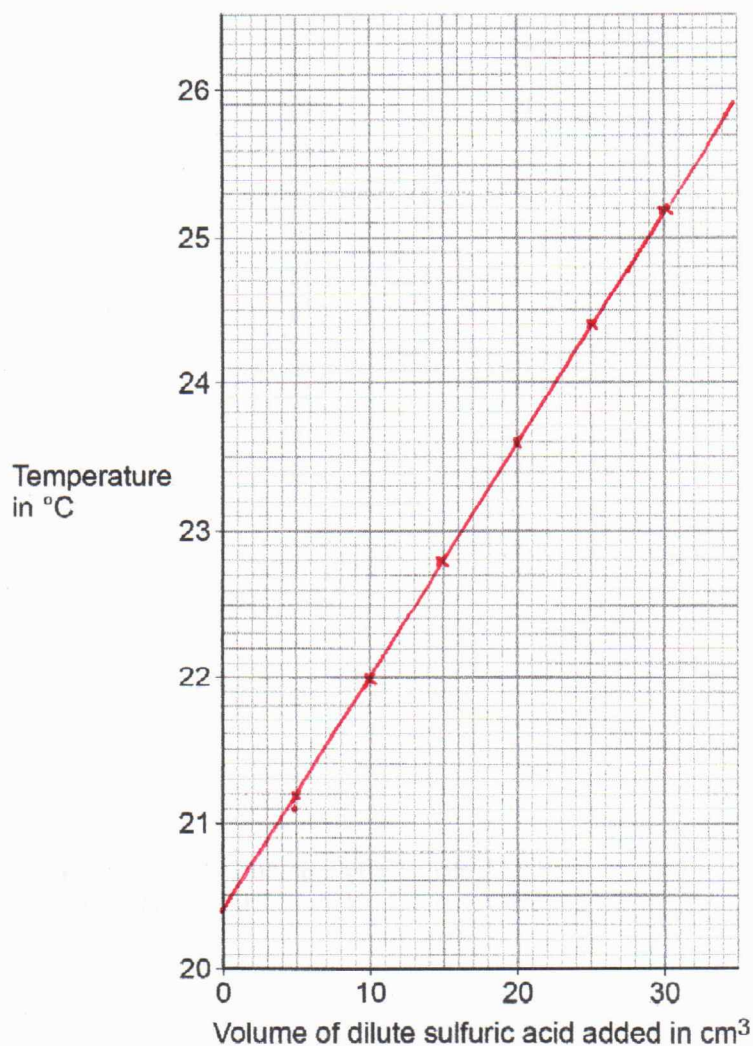
You should:

- draw a line of best fit
- extend your line of best fit to the y-axis.

[4 marks]



Figure 10



0 7 . 6

The intercept on the y-axis of Figure 10 shows the starting temperature of the potassium hydroxide solution.

Give the starting temperature of the potassium hydroxide solution.

[1 mark]

Starting temperature = 20.4 °C

Turn over ►



0 7 . 7

Another student repeated the investigation and obtained an anomalous result.

This result was lower than expected.

What could have caused the anomalous result?

[2 marks]

Tick (✓) **two** boxes.

The mixture was not stirred.

☒

The temperature in the room increased.

☐

The thermometer was not accurate.

☐

Too little sulfuric acid was added.

☒

Too much potassium hydroxide solution was used.

☐

11



0 8

This question is about the periodic table.

In the 19th century, some scientists tried to classify the elements by arranging them in order of their atomic weights.

Figure 11 shows the periodic table Mendeleev produced in 1869.

His periodic table was more widely accepted than previous versions.

Figure 11

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
Period 1	H						
Period 2	Li	Be	B	C	N	O	F
Period 3	Na	Mg	Al	Si	P	S	Cl
Period 4	K Cu	Ca Zn	* *	Ti *	V As	Cr Se	Mn Br
Period 5	Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	* I

0 8

1

The atomic weight of tellurium (Te) is 128 and that of iodine (I) is 127

Why did Mendeleev reverse the order of these two elements?

[1 mark]

He reversed so that elements such as iodine and tellurium were in groups with similar properties.



0 8 . 2

Mendeleev left spaces marked with an asterisk *

He left these spaces because he thought missing elements belonged there.

Why did Mendeleev's periodic table become more widely accepted than previous versions?

[3 marks]

Mendeleev's had Predicted the Properties
of missing elements and these elements
discovered had to fill the gaps (spaces).
The properties of these elements matched
the Mendeleev's predictions.

0 8 . 3

Mendeleev arranged the elements in order of their atomic weight.

What is the modern name for atomic weight?

[1 mark]

Tick (✓) one box.

Atomic number

☐

Mass number

☐

Relative atomic mass

☒

Relative formula mass

☐

0 8 . 4

Complete the sentence.

[1 mark]

In the modern periodic table, the elements are arranged in order of

Increasing in the atomic number.

Turn over ►



Chlorine, iodine and astatine are in Group 7 of the modern periodic table.

0 8 . 5

Astatine (At) is below iodine in Group 7.

Predict:

- the formula of an astatine molecule
- the state of astatine at room temperature.

[2 marks]

Formula of astatine molecule

At₂

State at room temperature

solid

0 8 . 6

Sodium is in Group 1 of the modern periodic table.

Describe what you would see when sodium reacts with chlorine.

[2 marks]

The sodium burns in an orange flame,
forming a white solid of sodium
chloride. The colour of the chlorine gas
disappears.



0 9

This question is about acids and alkalis.

0 9 . 1

Which ion do all acids produce in aqueous solution?

[1 mark]

Tick (✓) one box.

 H^+ ☒ H^- ☐ O^{2-} ☐ OH^- ☐*- alkali in aqueous solution.*

0 9 . 2

Calcium hydroxide solution reacts with an acid to form calcium chloride.

Complete the word equation for the reaction.

[2 marks]

calcium hydroxide + hydrochloric acid → calcium chloride + Water.

Question 9 continues on the next page

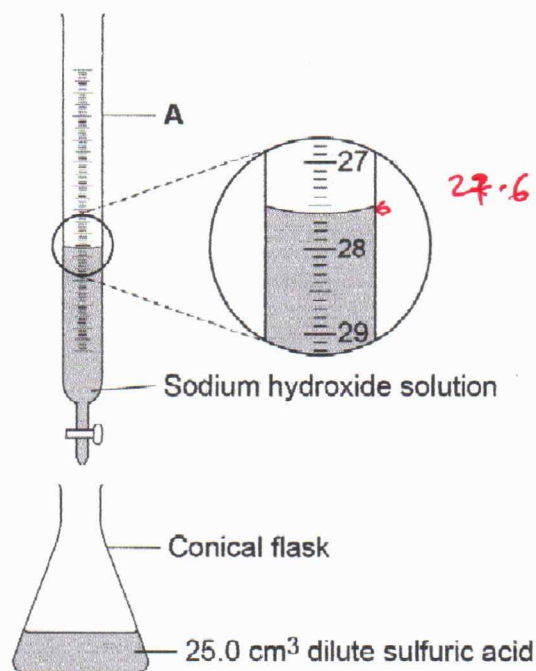
Turn over ►



A student investigates the volume of sodium hydroxide solution that reacts with 25.0 cm^3 of dilute sulfuric acid.

Figure 12 shows the apparatus the student uses.

Figure 12



Use Figure 12 to answer Questions 09.3 and 09.4

0 9 . 3

Name apparatus A.

[1 mark]

burette

0 9 . 4

What is the reading on apparatus A?

[1 mark]

27.6

cm^3



0 9 . 5

The higher the concentration of a sample of dilute sulfuric acid, the greater the volume of sodium hydroxide needed to neutralise the acid.

The student tested two samples of dilute sulfuric acid, P and Q.

Describe how the student could use titrations to find which sample, P or Q, is more concentrated.

[6 marks]

You are required to measure the volume of the acid, add indicator to the acid. Then add sodium hydroxide solution until colour changes. Record volume of sodium hydroxide solution added, repeat the procedure with other acid. Obtain the results from the titrations, then compare the two volumes of sodium hydroxide solution and then find the sample which is more concentrated, whether it is P or Q.



1 0

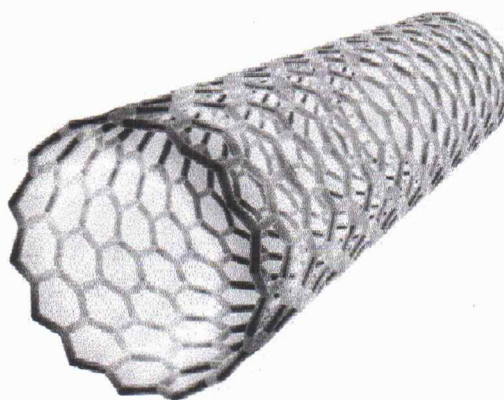
This question is about materials and their properties.

1 0

1

Figure 13 shows a carbon nanotube.

Figure 13



The structure and bonding in a carbon nanotube are similar to graphene.

Carbon nanotubes are used in electronics because they conduct electricity.

Explain why carbon nanotubes conduct electricity.

[2 marks]

They contain delocalised electrons, so the electrons can move easily through the structure.

1 0

2

Figure 14 shows a badminton racket.

Figure 14

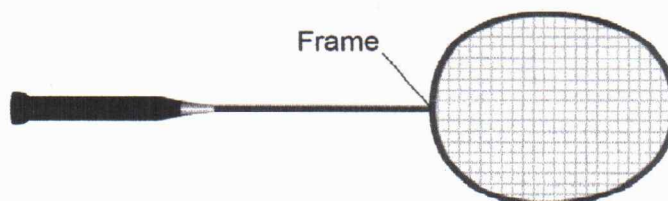


Table 4 shows some properties of materials.

The materials could be used to make badminton racket frames.

Table 4

Material	Density in g/cm^3	Relative strength	Relative stiffness
Aluminium	2.7	0.3	69
Carbon nanotube	1.5	60	1000
Wood	0.71	0.1	10

Evaluate the use of the materials to make badminton racket frames.

Use Table 4.

[4 marks]

The carbon nanotubes have the highest relative strength and able to hit ball further with racket and withstand force. Carbon nanotubes also have highest relative stiffness out of the three, means the racket will not bend. Wood has lightest density and makes them light. Overall I believe carbon nanotubes are best material and has the best strength, stiffness and has a reasonable density.

Question 10 continues on the next page

Turn over ►



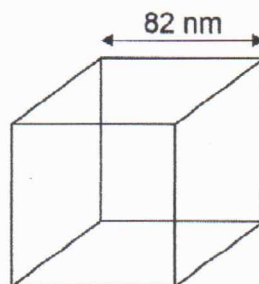
Zinc oxide can be produced as nanoparticles and as fine particles.

1 0 . 3

A nanoparticle of zinc oxide is a cube of side 82 nm

Figure 15 represents a nanoparticle of zinc oxide.

Figure 15



Calculate the surface area of a nanoparticle of zinc oxide.

Give your answer in standard form.

[3 marks]

$$\text{Surface area} = (82\text{nm} \times 82\text{nm}) \times 6 \text{ faces of a cube}$$

$$= (6724\text{nm}^2) \times 6$$

$$= 40344\text{nm}^2 = 4.0344 \times 10^4$$

$$\text{Surface area} = 4.0344 \times 10^4 \text{ nm}^2$$

1 0 . 4

Some suncreams contain zinc oxide as nanoparticles or as fine particles.

Suggest one reason why it costs less to use nanoparticles rather than fine particles in suncreams.

[1 mark]

Nanoparticles have longer lasting antibacterial properties than bigger particles of silver.

END OF QUESTIONS

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